

Securing the health benefits from reducing household air pollution:

What do we need to do?


How can new WHO Guidelines help?



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Dr Nigel Bruce

Department of Public Health and Policy, University of Liverpool



The issue ... lack of access to clean, efficient and safe household energy for 40% of the world's population

GBD 2010

- 2.8 billion use solid fuels for cooking
- HAP >> AQGs
- 3.5 (2.7, 4.5) million premature deaths (ALRI, COPD, CVD, Ca lung)
- 0.5 million OAP deaths
- Not counting ...
 - LBW, SB, TB, other cancers, asthma, &c.
 - Burns and scalds
 - Impacts on time, economic development, the environment, etc.

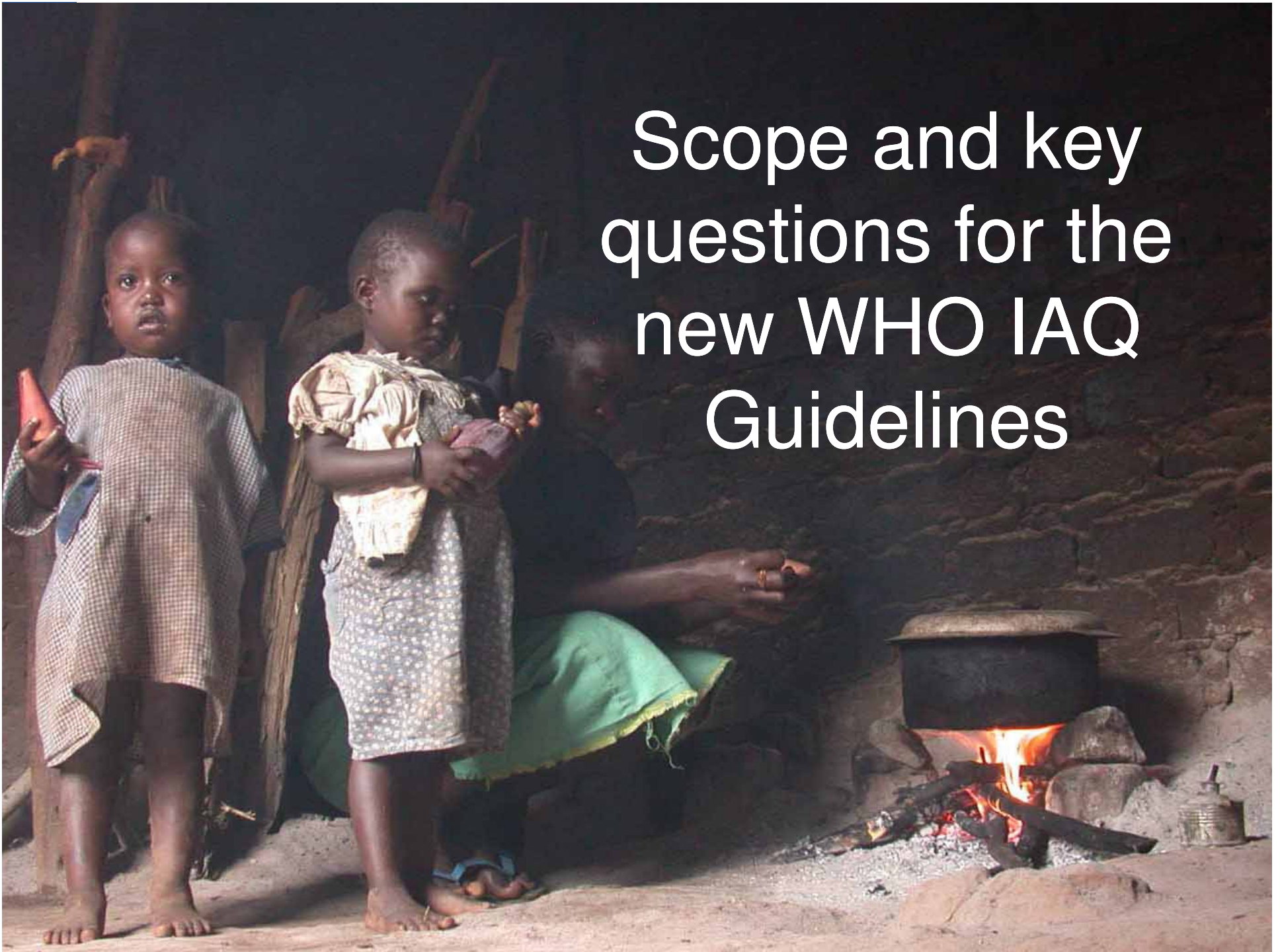
What progress is being made?

- Growing recognition of the problem:
 - UN Foundation Alliance
 - Sustainable energy for all by 2030
 - Climate and Clean Air Coalition
- But ... some critical issues and questions:
 - What interventions and policies are available
 - Are these delivering health benefits (and can they)?
 - What about sustainable, equitable adoption and use?
 - What more needs to be done?
- WHO indoor AQGs for household fuel combustion:
 - Designed to help address these questions
 - Nearing completion

Overview of presentation

- Scope and key questions for the new Guidelines
- Existing WHO air quality guidelines
- Evidence reviewed:
 - Project provided opportunity to conduct comprehensive overview of topic
 - Focus on 3 reviews
- Provisional recommendations
- Implementation plans

Scope and key questions for the new WHO IAQ Guidelines



Scope and key questions

Scope:

- Global, with focus on LMIC (highest burden)
- All uses, including cooking, heating and lighting

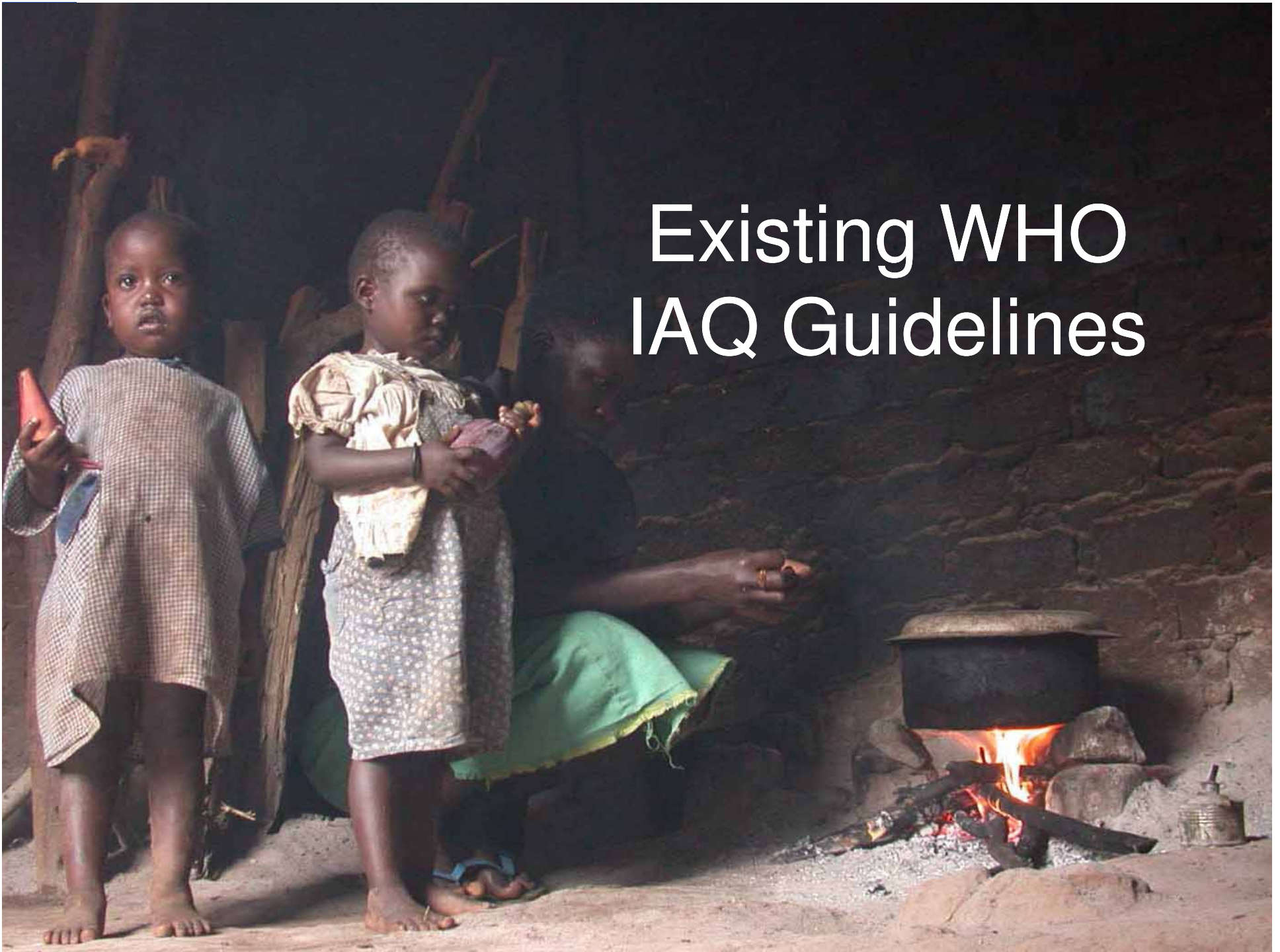
Key questions:

- What device and fuel emission rates are required to meet WHO (annual average) air quality guideline and interim target-1 for PM_{2.5}, and the (24-hr average) air quality guideline for CO?
- In light of the acknowledged challenges in securing rapid adoption and sustained use of very low emission household energy devices and fuels, particularly in low income settings, what approach should be taken during this transition?
- Should coal be used as a household fuel?
- Should kerosene be used as a household fuel?

Additional issues addressed

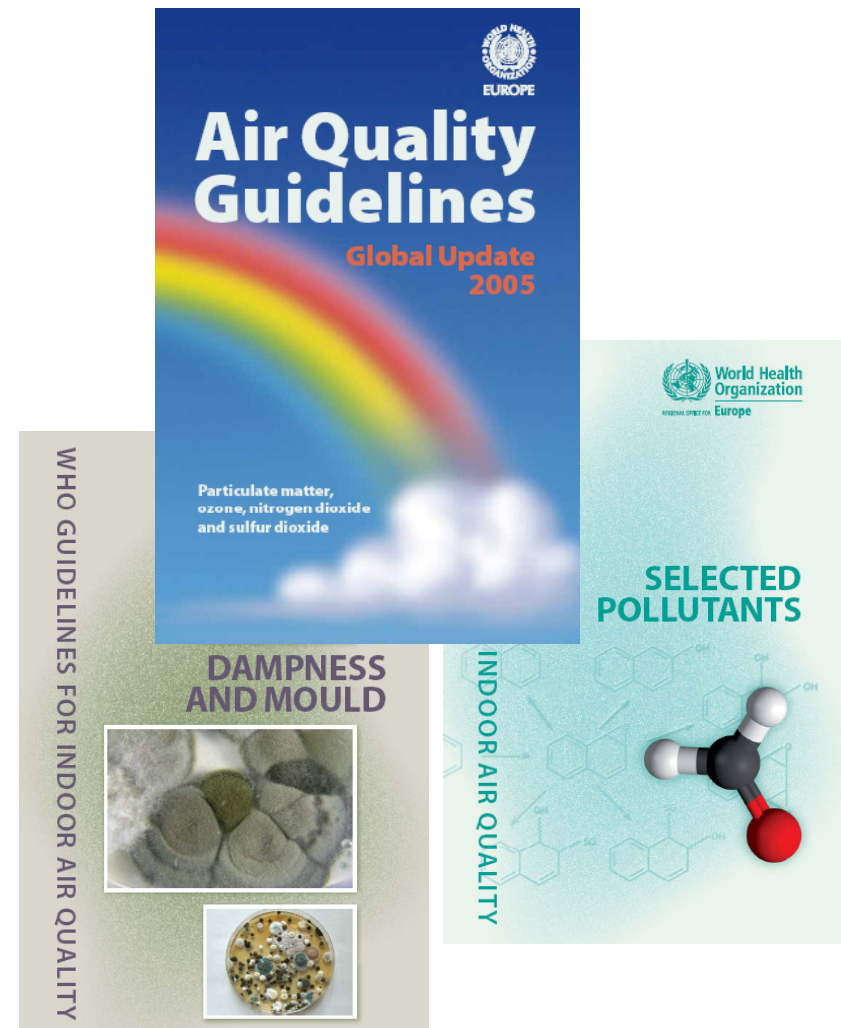
1. The home does not exist in isolation:
 - Emissions from household combustion contribute outdoor air pollution, some of which re-enters homes
 - Outdoor air pollution from any source (including neighbours' houses) enters homes
2. Household fuel combustion devices/fuels linked to increased risks for burns, scalds, fires, and poisoning
3. There are substantial challenges in achieving sustained adoption of effective HH energy interventions – especially for poorer, rural homes
4. Growing evidence on synergies between health and climate impacts

Existing WHO IAQ Guidelines



Existing WHO Air Quality Guidelines (AQG)

- Global update (ambient) 2005:
 - PM2.5, PM10
 - Chapter on IAP
- Indoor AQG:
 - Dampness and Mould: 2009
 - Selected pollutants: 2010
 - Household fuel combustion: this project



WHO Air Quality Guidelines:

PM_{2.5} and carbon monoxide (CO)

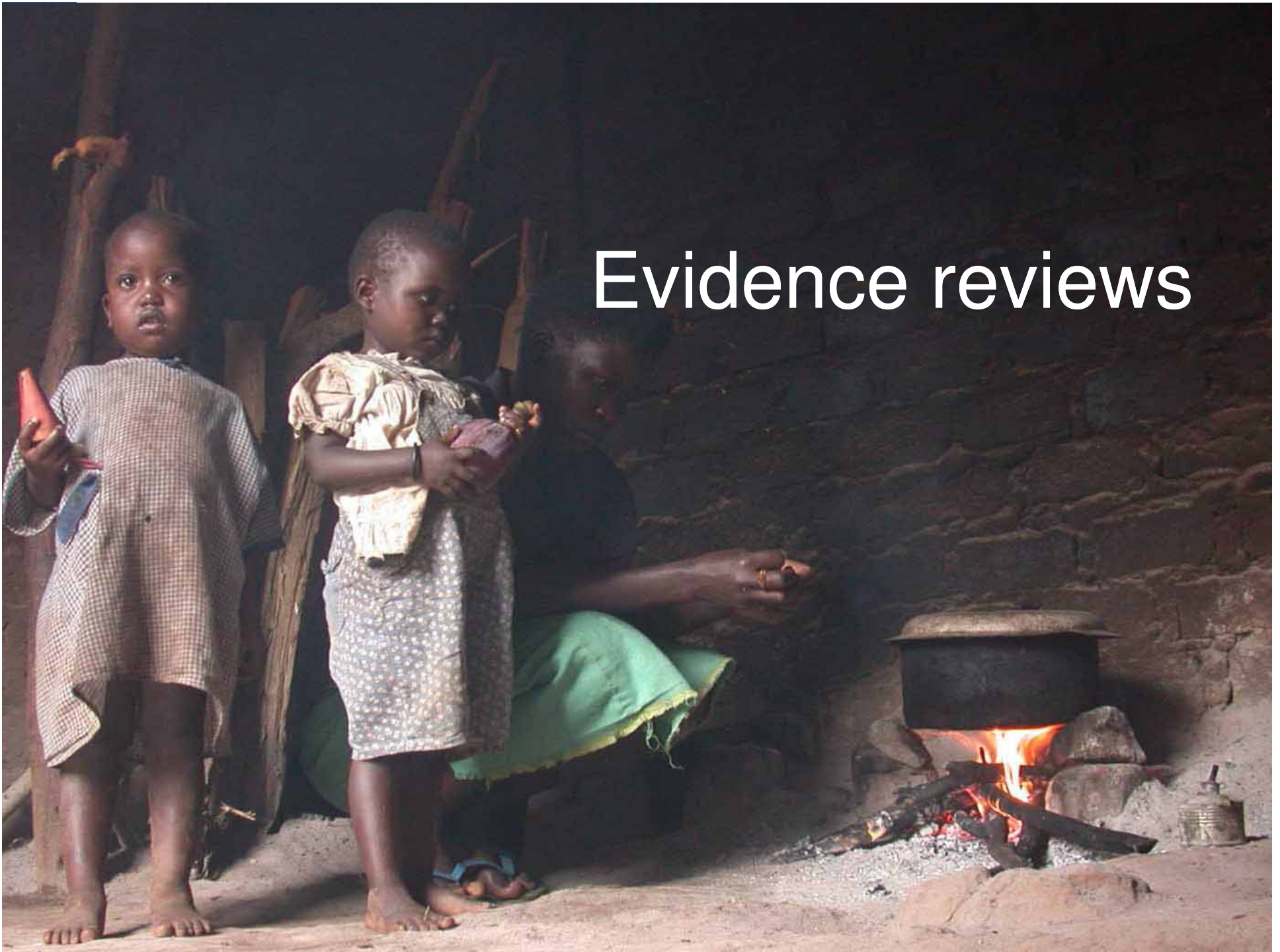
Pollutant	Guideline or target	Exposure period	Level (µg/m ³)
PM _{2.5} (2005)	Guideline	Annual average	10
	IT-3		15
	IT-2		25
	IT-1		35
Pollutant	Guideline or target	Exposure period	Level (mg/m ³)
Carbon monoxide (2010)	Guideline	8-hour	10
	Guideline	24-hour	7

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Evidence reviews



Key evidence themes reviewed

1. Fuel use, emissions and pollution levels:

- Global patterns of household fuel use
- Emissions of health-damaging pollutants
- Model linking emission rates with air quality
- Population levels of household air pollution

2. Health impacts:

- Health risks from household air pollution (exposure-risk)
- Specific risks from household use of coal
- Risks of burns, scalds and poisoning

3. Implementation - interventions and policy:

- Impacts of interventions in daily use on PM_{2.5} and CO
- Factors enabling and limiting adoption
- Interventions costs and financing options

Key evidence themes for Guidelines

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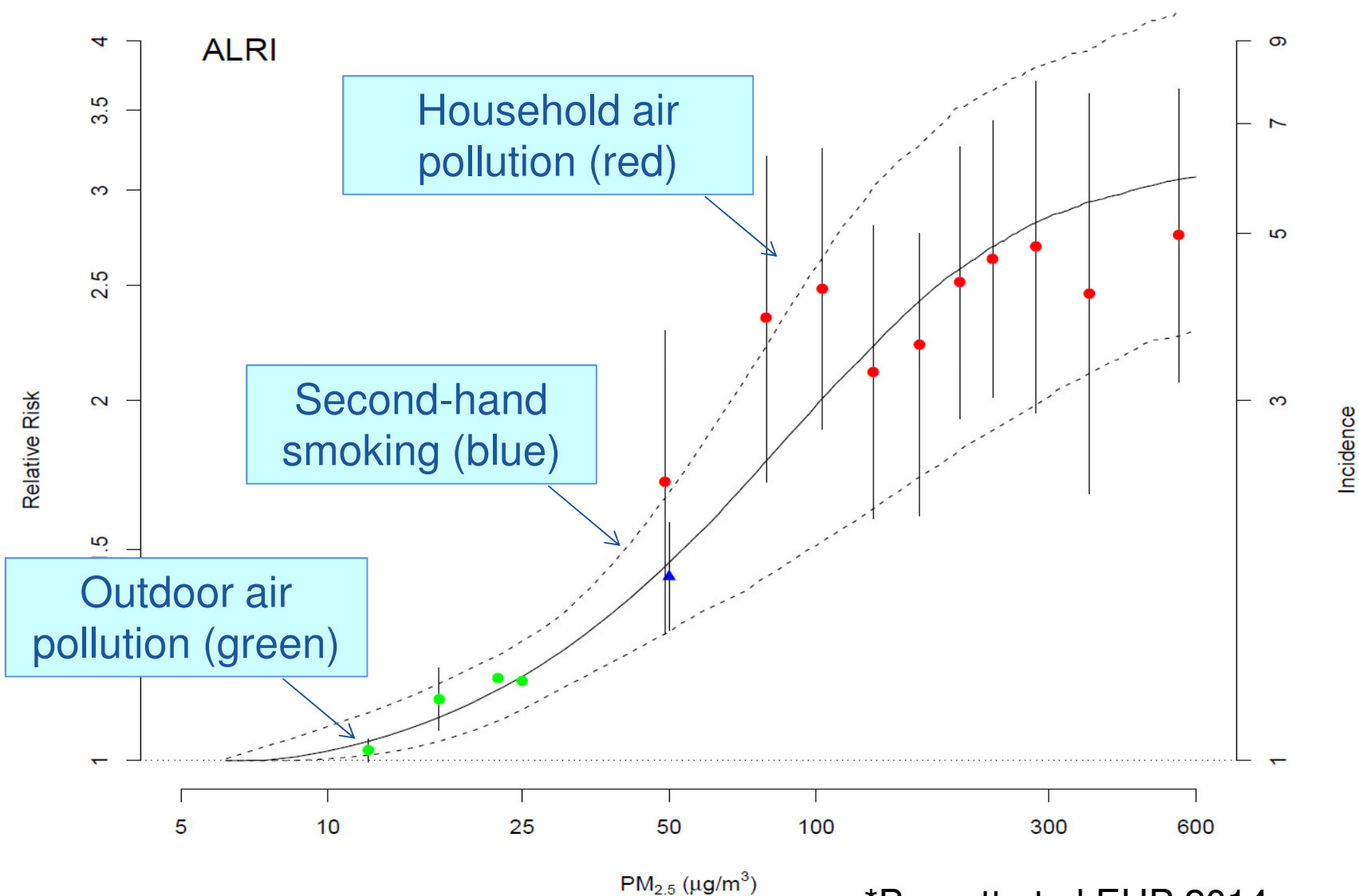
1: Health risks from exposure to HAP

Set of recent/new systematic reviews:

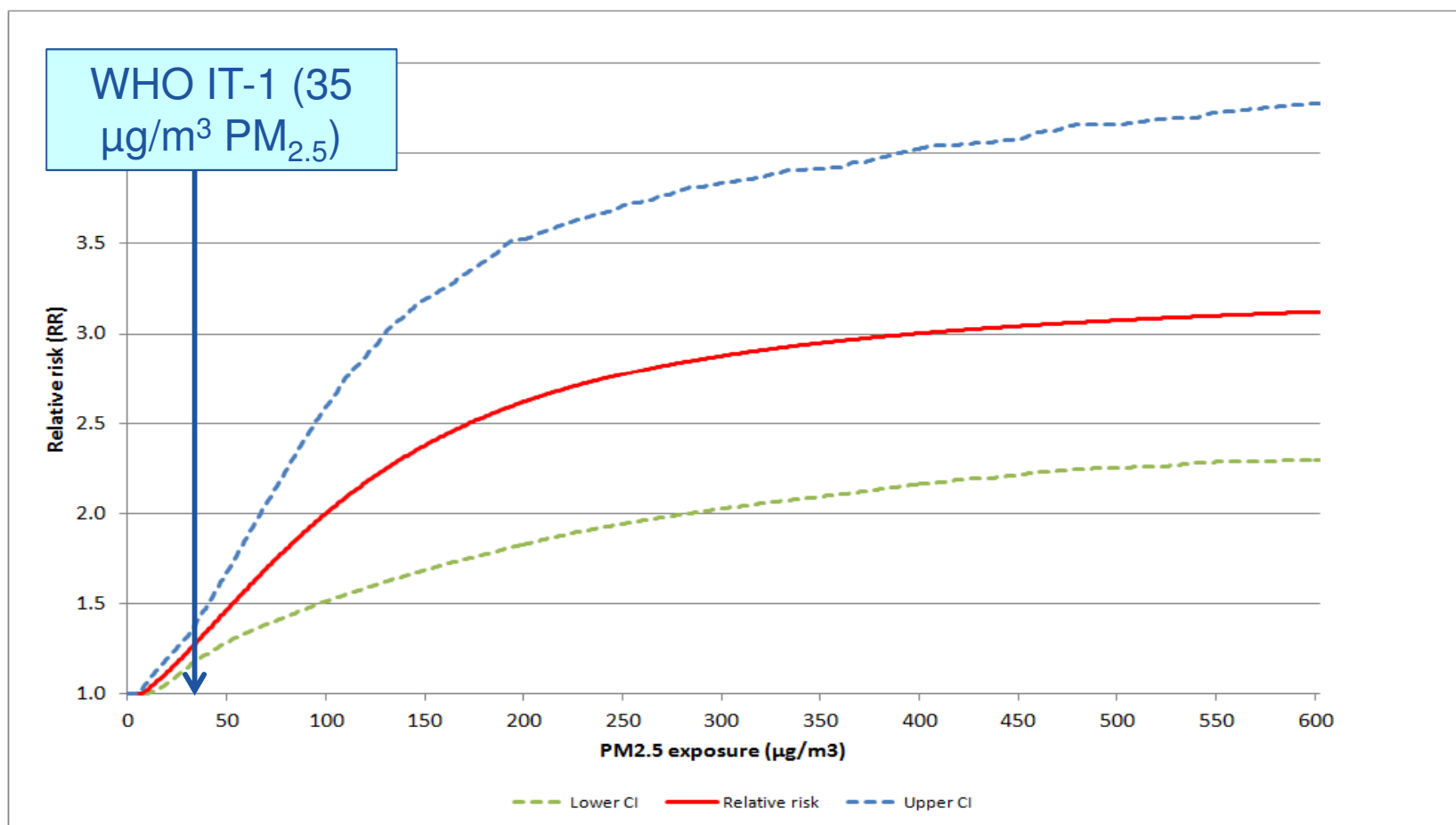
Strong evidence	Tentative evidence
<ul style="list-style-type: none">• Child pneumonia• Low birth weight• Chronic obstructive pulmonary disease (COPD)• Lung cancer (coal)• Lung cancer (biomass)• [Cardiovascular disease]• Cataract	<ul style="list-style-type: none">• Stillbirth• Pre-term birth• Stunting• Cognitive development• Asthma• Other cancers (naso-pharynx, uterine cervix)• Tuberculosis

Also: health risks from kerosene and gas

IER function*: PM_{2.5} and child ALRI risk



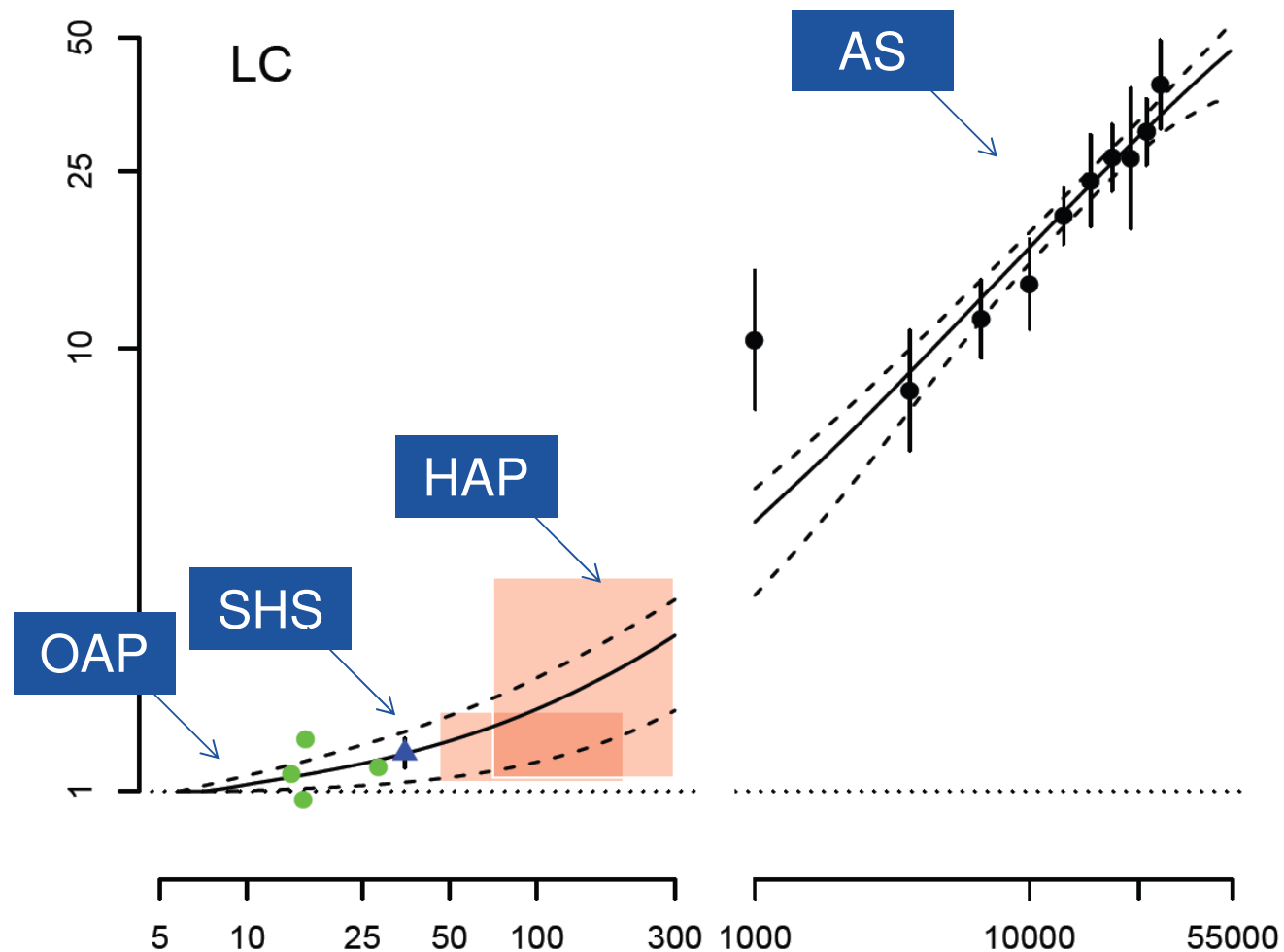
IER function for PM_{2.5} and child ALRI risk (linear scale)



IER functions included

- Child ALRI
- Ischaemic heart disease
- Stroke
- Lung cancer
- Chronic obstructive lung disease

IER function: lung cancer



2: Impacts of interventions - daily use (PM_{2.5})

Device and fuel type	Number of studies (estimates)	Kitchen PM _{2.5} (µg/m ³)		
		Pre-intervention mean	Post-intervention mean	Summary % reduction (95% CI) in mean
Solid fuel unvented	4 (7)	780	410	-48% (-34, -54)
Solid fuel vented	18 (23)	1030	370	-63% (+14, -89)
Advanced solid	1 (3)	650	380	-41% (-29, -50)
Ethanol	4 (4)	720	120	-83% (-63, -94)
Gas	1 (2)	890	280	-64% (-48, -80)
Electricity	1 (1)	160	80	-50% (N/A)

WHO annual AQG = 10 µg/m³

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Device and fuel type	Number of studies (estimates)	Kitchen CO (ppm)		
		Pre-intervention mean	Post-intervention mean	Summary % reduction (95% CI) in mean
Solid fuel unvented	5 (8)	11.1	6.6	-39% (-11, -55)
Solid fuel vented	17 (22)	11.5	4.2	-63% (-23, -86)
Advanced solid	1 (3)	11.3	5.7	-50% (-41, -61)
Ethanol	2 (4)	33.0	5.9	-82% (-75, -95%)
Gas	1 (2)	11.5	2.7	-69% (-48, -80%)
Electricity	1 (1)	1.3	0.7	-45% (N/A)

WHO 24-hr AQG = 7 mg/m³ (6.11 ppm)

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WHO 24-hr AQG = 7 mg/m³ (6.11 ppm)

3. Factors impacting on adoption

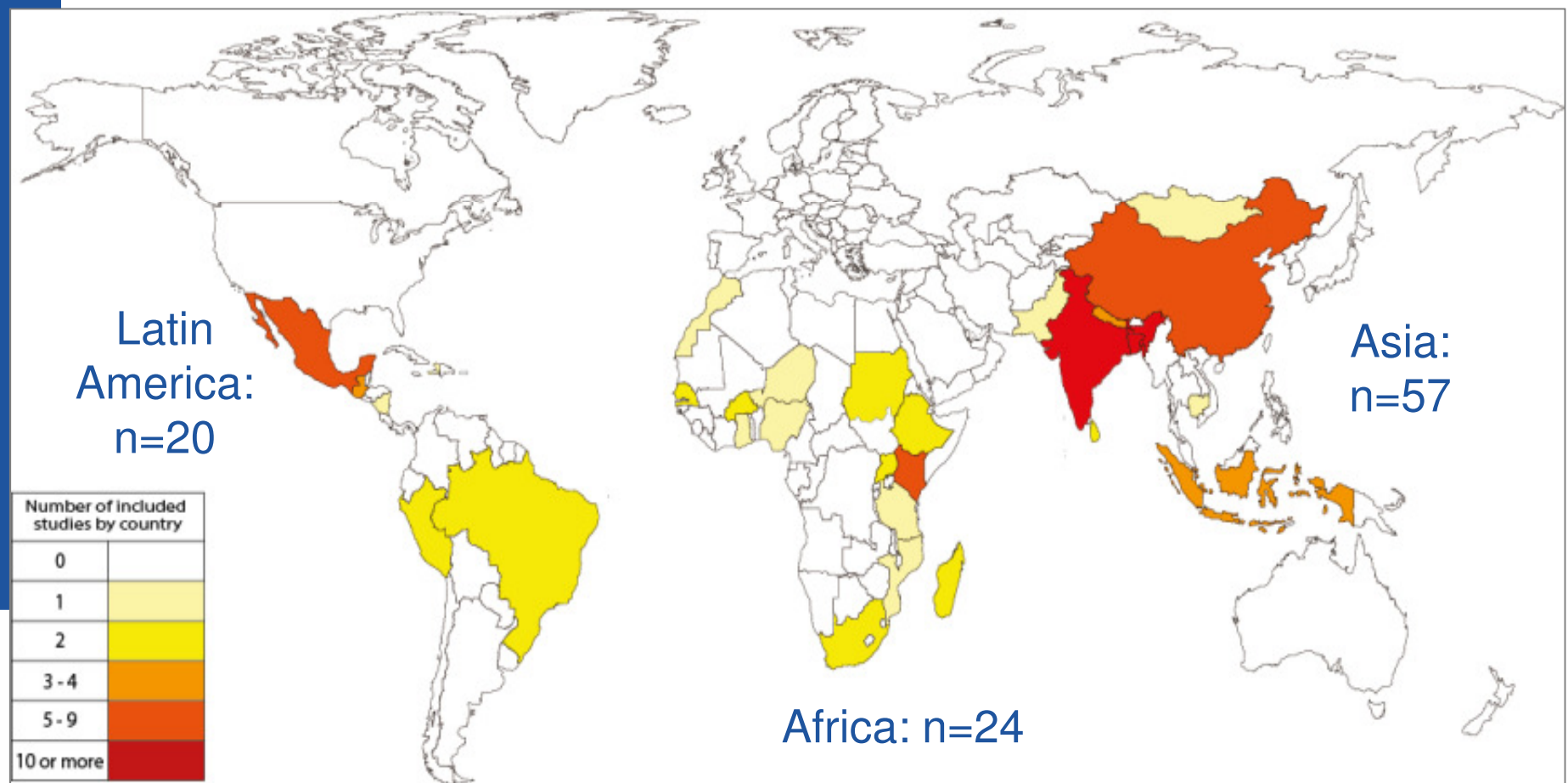
- Fuel and technologies:
 - Solid fuel 'ICS'
 - Clean fuels: gas, biogas, solar, ethanol
- Mixed methods (1980-2012)
 - Quantitative (e.g. surveys)
 - Qualitative (e.g. interviews, FGDs)
 - Case and policy studies (mix of data)
- Criteria for inclusion of studies:
 - Empirical studies based on direct experience with interventions
 - Use of solid fuels or kerosene for cooking prior to intervention
- Sources:
 - Multi-bibliographic electronic databases
 - Websites, reports, expert consultation

Puzzolo E et al:
Environ Health
Perspect. Feb 2014;
122(2): 120–130.

Numbers and sites of included studies

**Improved solid fuel stoves
(ICS)
(57 studies)**

**Clean fuels: LPG (n=12), biogas
(n=17) solar cookers (n=9),
alcohol fuels (n=6)**



Framework of domains influencing adoption

1. Fuel and technology characteristics

Household and community level

2. Household & setting characteristics

3. Knowledge and perceptions

Programme and societal level

4. Financial, tax and subsidy aspects

5. Market development

6. Regulation, legislation and standards

7. Programmatic & policy mechanisms

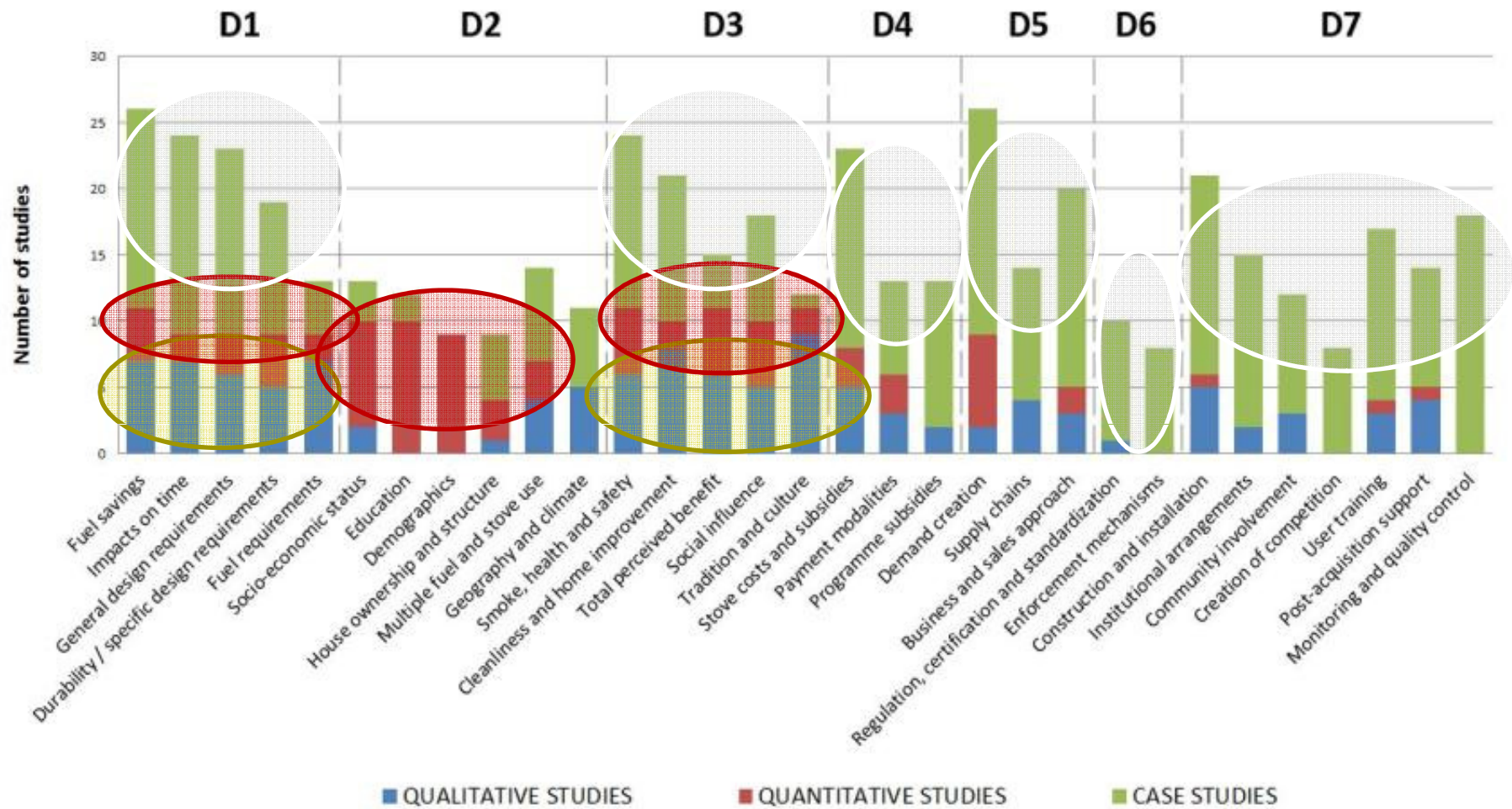
EQUITY

Adoption at
scale



Sustained use
at scale

Multiple factors across 7 domains: ICS



D1: Fuel and technology characteristics

D3: Knowledge and perceptions

D6: Regulation, legislation and standards

D2: Household and setting characteristics

D4: Financial, tax and subsidy aspects

D7: Programmatic and policy mechanisms

D5: Market development

Key findings

- What are most important, and how do we know?
 - Data does not support consistent means of identifying most important factors
 - Some emerge as ‘critical but not sufficient’, e.g. meeting household cooking needs, affordability, etc.
- All factors needs to be assessed:
 - Context and fuel dependent
- Some examples:
 - Time saving less important where women’s time is not valued
 - Provision of radiant heat in colder settings
 - Urban migration may be threatening viability of biogas
 - Policy to ensure reliable supply of LPG is required

Proposal for development of tool

- Based on findings of review (etc.)
- Function as a guide for country decision-making
- Key steps for community (country, area) or programme (e.g. fuel):
 - Review and assess all relevant factors
 - Determine whether each is enabling or a barrier
 - Compile findings by domain, indentify inter-relationships
 - Aim is to guide agenda-setting
- Develop and pilot test with countries

Provisional recommendations



Focus on emissions reductions – why?

- Outdoor \leftrightarrow indoor
- Evidence base stronger than for other approaches
- Implementation practicality – via design, production, standards, etc.
- Approach is fundamentally conservative
- Some options (clean fuels), are relatively independent of user behaviour.



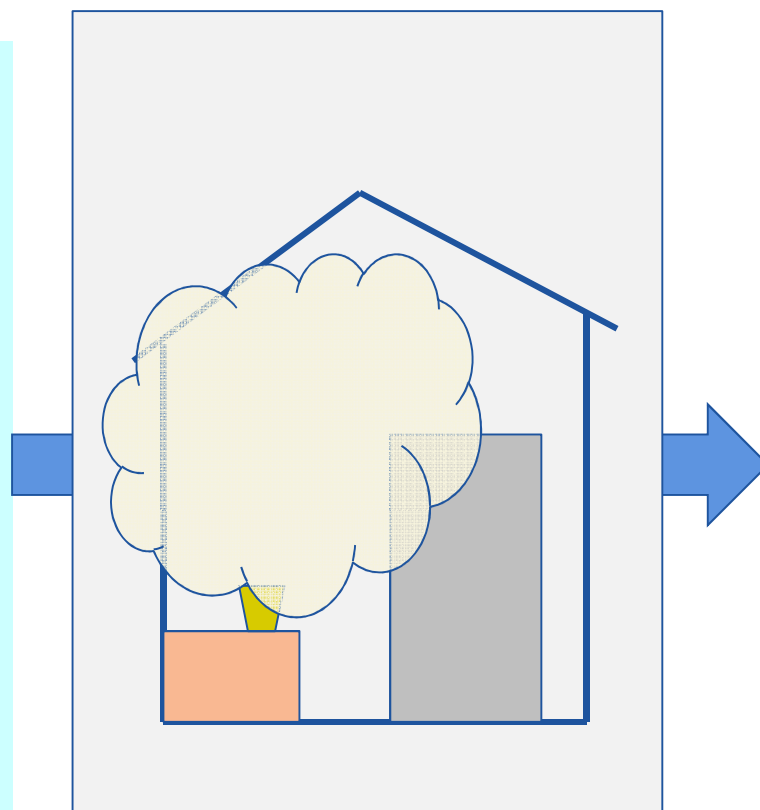
Provisional recommendations

- Recommendations currently undergoing the final stage of WHO approval.
- Provisional - following issues are addressed:
 - Emission rate targets
 - Policy during transition to very low emission technologies and fuels needed to meet AQGs
 - Household use of coal
 - Household use of kerosene
- Set of general considerations
 - Apply to all recommendations
- Climate and health co-benefits

Model linking emissions to air quality

Inputs:

- Emission rates:
 - PM2.5
 - CO
- Kitchen volume
- Air exchange rate
- Duration of use (hours per day)



Outputs:

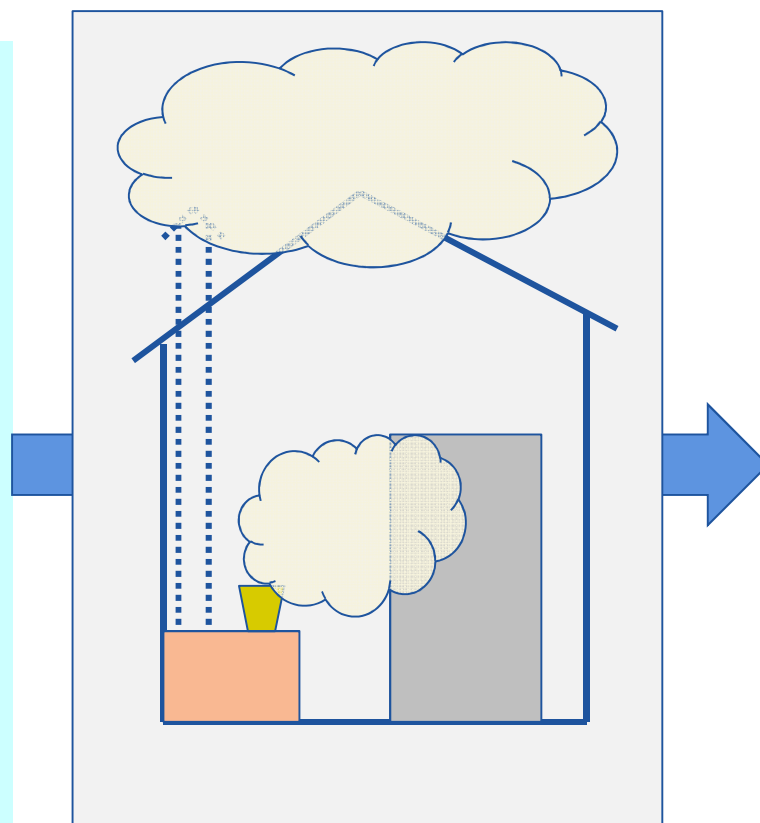
- Predicted average concentrations of:
 - PM2.5
 - CO

- Uses ranges of inputs and M/Carlo simulation
- Assumes uniform mixing of pollutants and air in kitchen

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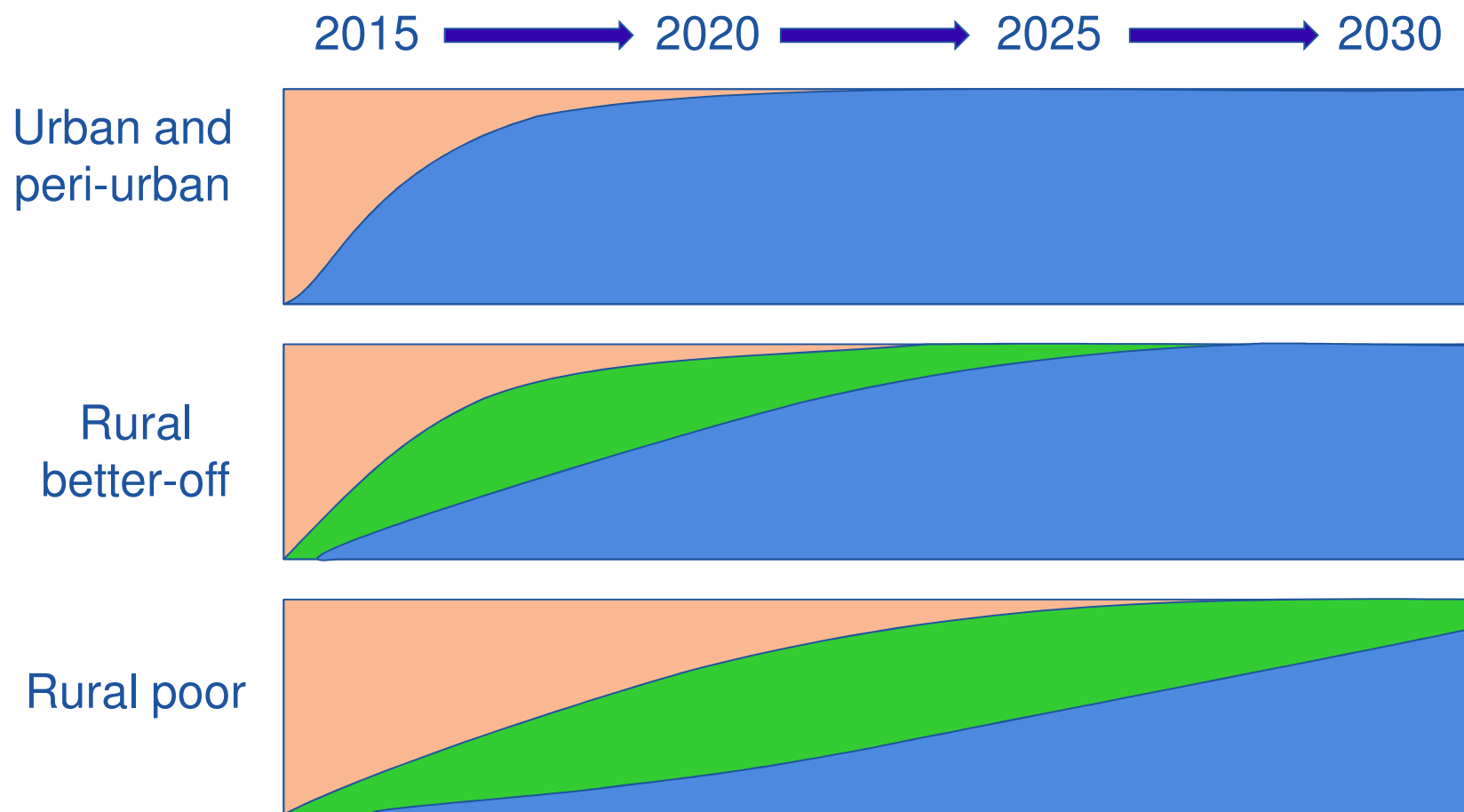
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HH energy transition: solid fuel users



Traditional
biomass

Low emission
biomass

Clean
fuel

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General considerations

- **Local ambient air quality** (from homes and other sources) affect indoor air quality: this must be considered in order to achieve clean indoor air.
 - Community wide action
 - Other ambient air pollution sources
- **Homes have multiple energy needs** (cooking, heating, lighting, etc.) so use and emissions from all sources should be considered.
- **Safety:** Household energy use carries risks of burns and poisoning:
 - Safety of interventions should not be assumed
 - Approaches to minimize exposure to emissions should be taken in a way that incorporates safety concerns.

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 - Apply to all recommendations
- **Climate and health co-benefits**

IAQG: Research recommendations

- Comprehensive field intervention evaluation:
 - Impacts on HAP and exposure, safety
 - Acceptability, use, affordability and finance
- Health risks and impacts:
 - Intervention impacts (RCTs, etc) and E-R
 - Strengthen where direct HAP evidence is tentative (TB, CVD, etc.)
 - Cleaner coals; kerosene
- Policy for sustainable transition to low-emission technologies and fuels
- Methods and tools for M&E

Implementation plans



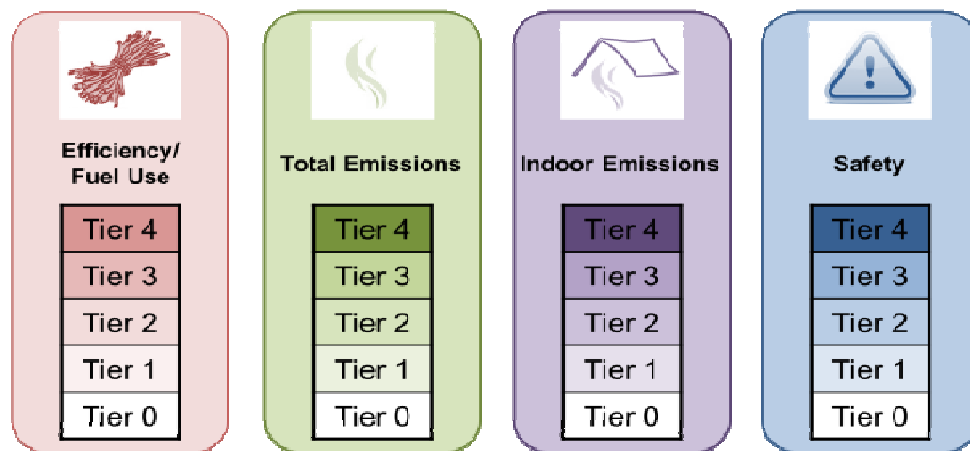
Guidelines implementation

- Web-based guidance/tools, including:
 - Methods for country-based needs assessment
 - Interactive version of emissions model (allowing regionally derived inputs)
 - Tool for assessing health impacts and costs of intervention options (IER functions) - HAPIT
 - Tool for planning policy for effective adoption
 - Methods for monitoring and evaluation
- Country support:
 - General support for all countries
 - Work closely with 5-6 countries to develop and evaluate guidance and tools

Standards, testing and certification

2012 – led to ISO ‘IWA’:

- 4 dimensions, each with 4 tiers
- GACC supporting development of regional testing centres
- Resolution to link next stage with new WHO IAQ Guidelines



Water Boiling Test 4.1.2, now WBT 4.2.2
and additional protocols ...

Biomass Stove
Safety Protocol

2013 – ISO TC 285 established:

- To develop ISO standards
- Met February 2014 in Nairobi
- WHO is Category-A Liaison organisation

Will look at:

- Lab and field tests
- Adoption issues
- Safety of gas, &c.

Basis for regulation, etc.

Thanks!

